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INTRODUCTION

The prospect of facing a massive ground attack under unfavorable conditions of environment and force ratio is not a happy one. The defender's problem, vastly oversimplified, is to manage his resources in such a way as to execute his mission and to survive. This means that the defender on the ground must be capable of engaging effectively (servicing) enough discrete enemy targets over time to cause the attacker to pause or to abandon the attack. Imbedded in this concept is the notion of interfering with the attacker's forward flow, limiting his ability to bring overwhelming numbers of armored vehicles to bear on the defender.

This view of the problem has stimulated a growing perception that disruption and delay may be meaningful objectives. In the attacker's tactical rear areas, destruction of vehicles, supplies, and point targets would contribute to the disruption and delay effects, while attrition would dilute available combat power. What we are suggesting is that targeting be directed toward the broader effects of disruption, of which discrete destruction is a part. This type of targeting provides an opportunity for the employment of air power directed toward the exploitation of an attacker's rear area vulnerabilities.

The foregoing concept leads to the notion that a lie-in-wait munition might have utility in a mix of weaponry: Air scatterable land mines now in development may well be that munition. Possessing characteristics that seem to be complementary to those of immediate

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effects weapons, air scatterable land mines give promise of improved lethality against armored targets. We shall focus now on these mines as a munition and then suggest some opportunities for Air Force exploitation through delivery by tactical air.

MINE EFFECTIVENESS IN THE PAST

Although the two major effects involved--disruption and attrition--are not easily documented, we do have some data on armored vehicles that were destroyed in past conflicts. Table 1 indicates that about one-quarter of all armor casualties in World War II resulted from mine encounter. Table 2 breaks this out by World War II theater and adds data from the conflicts in Korea and Vietnam. The marked differences between environments in the latter two and that in Western Europe account for some of this dramatic increase in effectiveness.

Table 1

ARMOR CASUALTIES IN WORLD WAR II BY CAUSE[1]

Kill Agent	Percent
Artillery and antitank weapons	59.8
Mines	23.7
Bazookas	17.0
Miscellaneous	0.5
Total	100.0

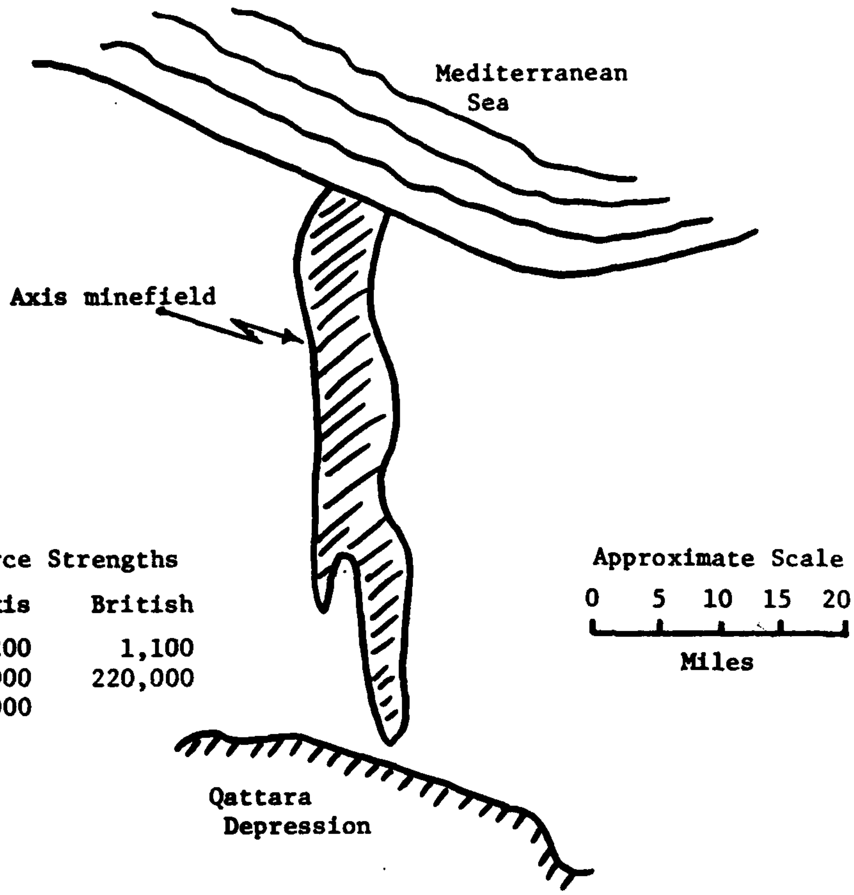
Table 2

ALLIES TANK LOSSES TO MINES AS A PERCENTAGE[2] OF LOSSES TO ALL ENEMY ACTION

Theater	Percent
North Africa, 1942-43	18
Western Europe, 1944-45	23
Italy, 1943-45	28
Pacific, 1944-45	34
Korea, 1950-51	56
Vietnam, 1967-69	69

A classic example of mines as a moderator of adverse force relationships is seen in the case of Rommel versus Montgomery at Alamein, sketched in Fig. 1. Rommel, on the short end of the combat ratio, used almost one-half million hand-emplaced mines in his defense. About 300,000 of these were antitank mines, almost one per meter of front in this 35- to 40-mile gap. It took a vastly superior British force 12 days to break through[3]--and Montgomery almost gave up the attack.[4] But consider the logistics involved: at normal rates of emplacement, it would require over 100,000 man-hours to develop this field. (Haiphong harbor was mined by aircraft in 18 minutes.)

These antique mines, acting only on the tracks of armored vehicles (less than one-quarter of the total vehicle width) so impressed Rommel that he asked for 200 million mines to shore up the defenses of Continental Europe. Fortunately, he did not get that many.



Opposing Force Strengths

	Axis	British
Tanks	200	1,100
Men	90,000	220,000
Mines	~500,000	

Fig. 1--Second battle of Alamein, 23 October 1942[3]

These descriptions provide some appreciation of the destructive potential of land mines despite their shortfalls: namely, time-consuming emplacement, logistic burden, vulnerability to countermeasures, limited range of effect, and lack of emplacement flexibility. But we have little hard data on the disruptive effect of mines, a subject coming under increasing examination as the potentials of scatterable mines begin to emerge.

DEVELOPMENTAL MINE SYSTEMS

Shaped charges, small in size and light in weight, provide an improved kill mechanism. Figure 2 shows what an air delivered mine weighing about 6 pounds can do to the belly armor of a tank weighing about 50 tons. In the antitank version, the magnetic influence fuze detonates the mine anywhere across the full width of the tank with a high probability of destroying or disabling it.

An antipersonnel version, identical in appearance, is initiated by trip-wires within the radius of which the warhead is lethal to unprotected personnel. This is the Gator mine system, now in advanced engineering development.

More sophisticated devices, wide area antiarmor munitions (WAAM), are still in the conceptual stage. After emplacement, a sensor system will activate and will seek an appropriate target; when one is detected within effective range, the warhead will be projected toward the target and will attack it with submunitions or an explosive charge. This type of munition could be emplaced well off a road or runway and still attack vehicles and aircraft some distance from its emplaced position. Such a capability would be useful in restricting enemy use of high speed routes of advance and, by its ability to attack from a remote location, also in extending the threat over a wide area. This characteristic, along with sophisticated fuzing and discrimination, will complicate countermeasures and generate a higher level of uncertainty, both of which contribute to the disruptive effect.

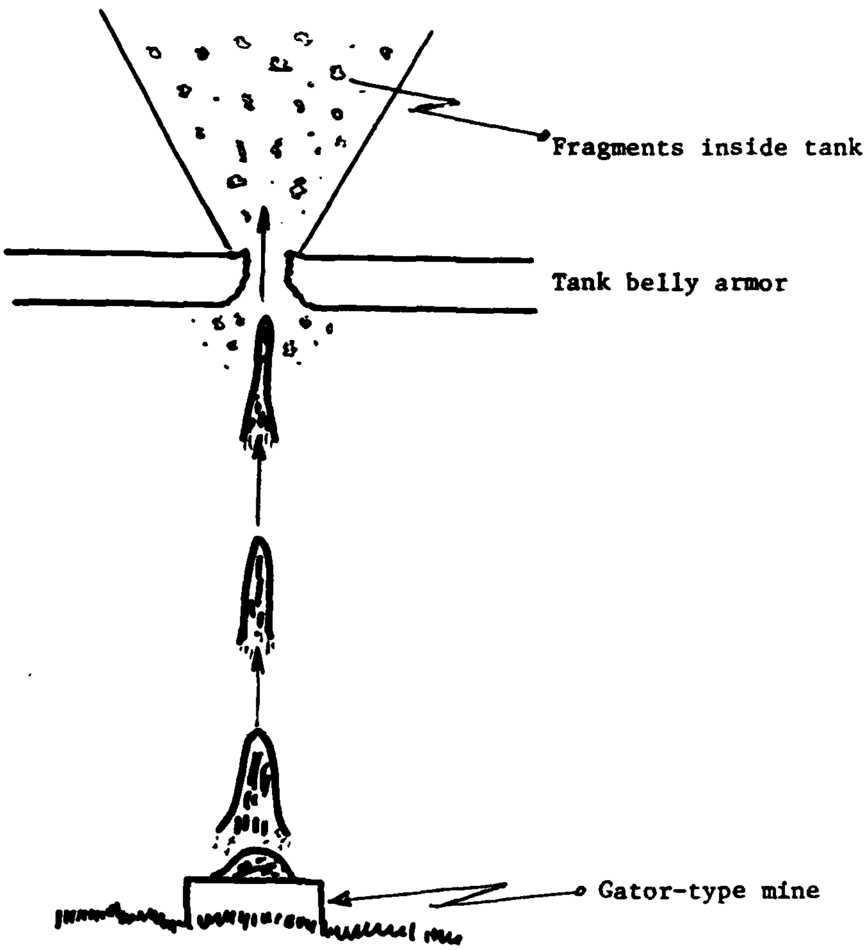


Fig. 2--Gator mine warhead functioning

This brief glimpse of new capabilities in mine materiel invites examination of new concepts for mine warfare, concepts which reach beyond the traditional modes of employment by the ground forces.

CURRENT MINE WARFARE DOCTRINE

Influenced by operational requirements and conditioned by past experience, ground forces planners stress these doctrinal elements:

Covering fire. Minefields are considered most effective when covered by observed ground fire. Such coverage provides additional time for servicing attacking vehicles as they slow or maneuver to avoid mines, while complicating the countermeasures activity. In this sense, mines are a force multiplier and any destruction that they cause is something of a bonus, sometimes overlooked.

Delivery accuracy. To be within ground weapons range and observation, the mines must be emplaced quite close to friendly troops in carefully plotted locations.

Self-destruct reliability. Proximate emplacement also means (1) that the mines will be in areas that the defender may desire to use again and, therefore, that (2) a high assurance of complete and timely self-destruction is required.

The logic of these requirements for mining near friendly troops is understandable, but it seems that such restrictions should not inhibit the examination of some types of mining for which the Air Force is particularly suited. For example, decreased emphasis upon precise mine emplacement (at some distance from friendly troops) would permit the use of less accurate delivery means, such as inexpensive standoff devices, while exploiting the lie-in-wait and area coverage characteristics of scatterable mines. Also important are the 24-hour and all

weather delivery possibilities which are improved by a lower requirement for precise and timely target location and acquisition. Similarly, mining some distance beyond the forward line of own troops (FLOT) would reduce the requirement for forward air controllers in the hostile air defense environment. Such a doctrinal revision would also affect mine hardware development: Reliable self-destruction would become less critical and a simple neutralization device might be all that is needed in Air Force scatterable mines.

OPPORTUNITIES FOR AIR FORCE EXPLOITATION

Rather than attempt to revise existing mine warfare doctrine to fit new materiel capabilities, we seek to devise concepts that will exploit this technology, perhaps even drive the direction of some developmental projects. Candidate aspects for examination include:

<u>Mix of systems</u>. The Warsaw Pact current countermine capability appears to be designed for use against current mine types and existing employment doctrine. And almost any type of mine can be countered, once its characteristics are known. Antidisturbance features, arming cycles, and selective fuze sensors can complicate countermeasures, but a mix of different fuzing and destruct mechanisms may be even more effective in defeating countermine activities. This suggests that mines with wide areas of effects, such as WAAM, may be worth their additional cost. Such a mix would make a minefield viable without covering fire.

Area employment. In the attacker's tactical rear area there is an opportunity to spread the threat of mine encounter into places normally considered to be relatively safe except when the defender's tactical air is present. Widespread, low density mining with some hot spots of higher density would return the elements of surprise and deception to mine warfare, increasing the attacker's uncertainty and apprehension.

Degrade command and control. High speed massive movements of armored vehicles require detailed plans and schedules. A few major mobility impedance events or a large number of minor disruptions hold promise of overloading fragile command and control links. If there is inflexibility in the Warsaw Pact capability to react rapidly and decisively to unexpected situations, some delay and disruption should result.

Develop targets for other weapons. Employing minefields in great depth to serve as obstacles or to enhance other obstacles tends to cause concentrations of combat and combat support vehicles. Targeting mine emplacement specifically to achieve this effect would provide enriched opportunities for attack using Air Force munitions suitable for discrete destruction.

Enhance effects of other weapons. The persistent nature of mines suggests their use to extend the effects of destruction by other means. Mining the site of a bridge destroyed by a precision guided munition (PGM), for example, would extend repair time while causing attrition to engineer troops and dispersing vehicles.

These and similar notions may be used together to subject an attacker to disruptive and destructive influences over greater time and space than has been possible in the past. In an effort to break away from the traditional ideas of current mine warfare doctrine and terminology, we will use the name metaminefield to characterize this set of ideas. The geometry and typical minefield design characteristics of the "old" ground forces doctrine are displayed in Fig. 3 as a point of departure. The clearly defined boundaries, width of field, and precision of mine groupings form a probable basis for the

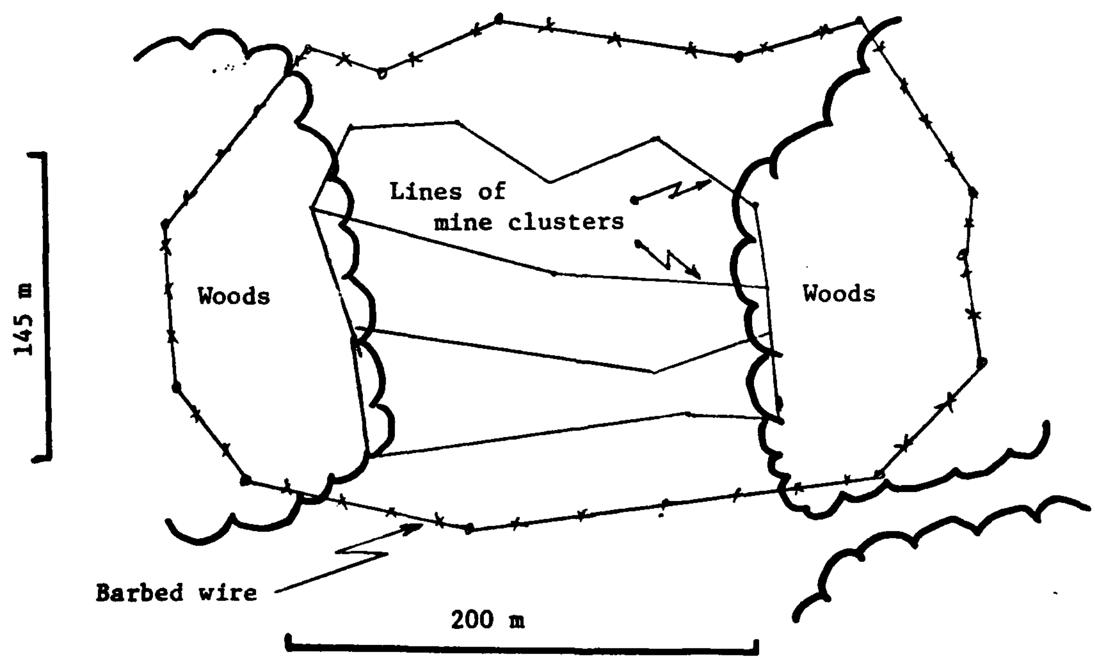


Fig. 3--Defensive minefield design pattern[7]

design of the impressive array of Warsaw Pact countermeasure gear--rollers, plows, explosive line charges. When an intruder encounters the first mine in a conventional geometric field, he has a good idea how far he has to clear before he emerges from the danger area.

In the metaminefield, a hot spot of relatively high density--a node--would impose about the same probability of kill upon an intruder. This is sketched in Fig. 4 to the same scale. The dots represent mines randomly scattered over the entire area, with no discernible geometry. If hand emplaced, the minefield in Fig. 3 would require about 300 man-hours; the field in Fig. 4 could be emplaced

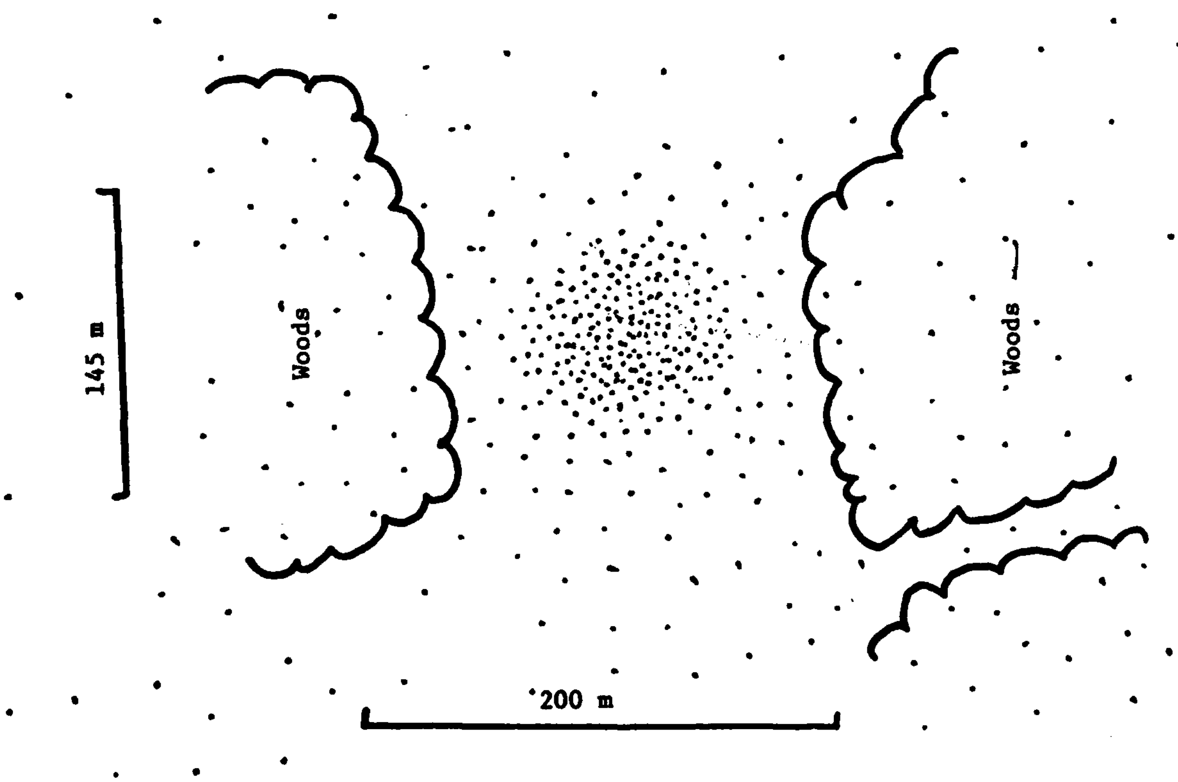


Fig. 4--Metaminefield node or hot spot

by one F-4 sortie. The total effect of this mining would extend over an area about 10 times the size of the older type minefield, with some chance of mine encounter beyond that.

A broader scale view of a metaminefield is depicted in Fig. 5. A mix of mine types is used in conjunction with other Air Force munitions to enhance the delaying potential of the terrain:

o At node 1 (N1), wide area or route traffic mines are emplaced to force vehicles into the woods where Gator-type mines are difficult to detect and avoid.

o At node 2, a precision guided munition (PGM) is used to destroy a bridge, with mine concentrations positioned to retard repair and cause some destruction of engineer equipment or bypassing vehicles.

o At node 3, a potential fording site is rendered inaccessible.

o Throughout the area are randomly scattered mines of various types, represented by dots. Each time an intruder encounters a mine, there is a good chance of attrition. And each time, the intruding commander must decide whether to adopt countermeasures, bull through and take his losses, or attempt to circumnavigate. He never knows when he is in a node or hot spot, and the lack of predictable geometry prevents his determining how deeply his force has penetrated into the mined area. Wide area mines pose a threat not only to the vehicles in whose paths they lie, but also to any vehicles in the area for some meters on either side. The uncertainty factor would compound psychological effects, a phenomenon we learned about in

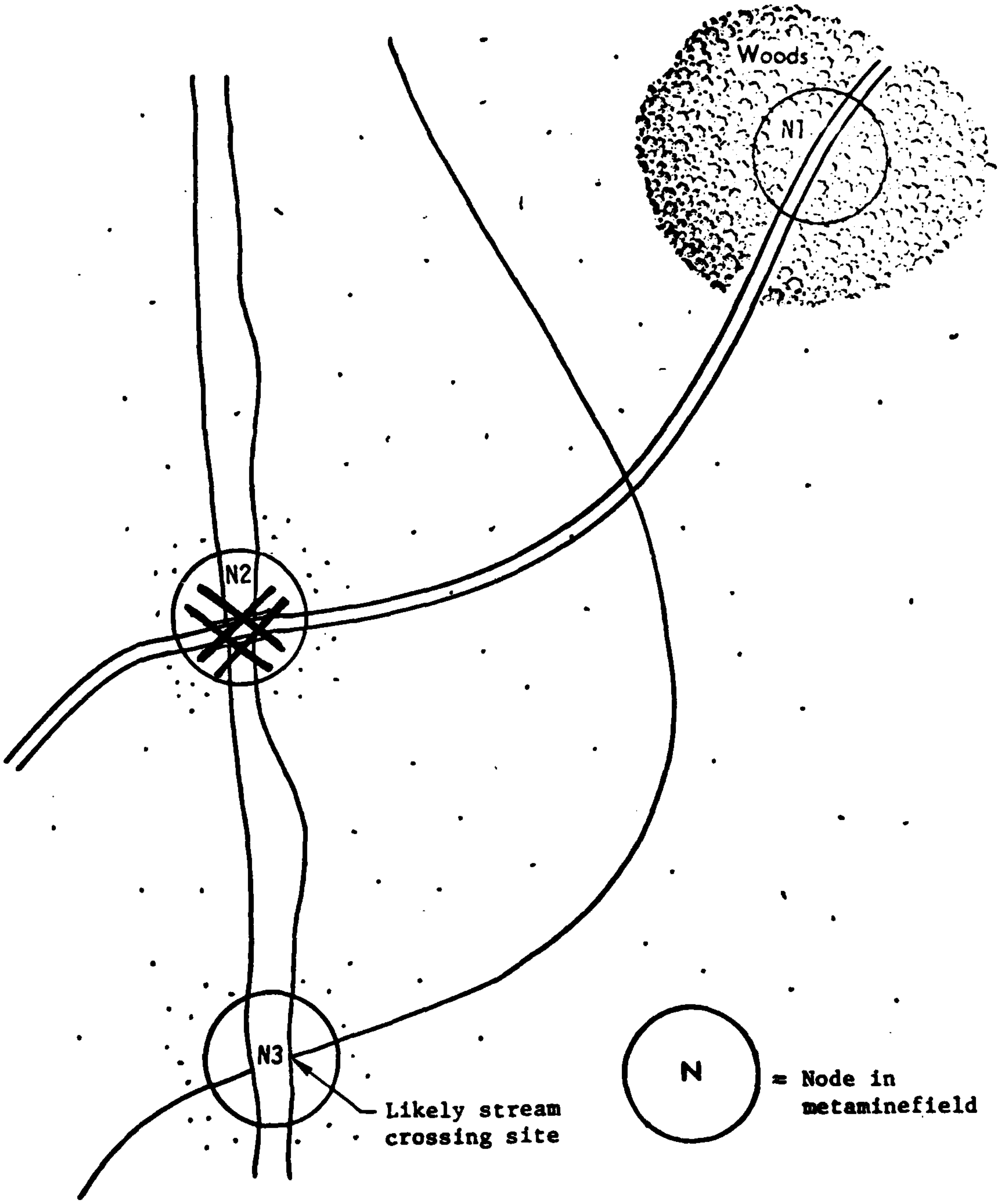


Fig. 5--Metaminefield emplacement scheme

Southeast Asia but have been unable to exploit. The intruding commanders, it is hoped, would increase radio usage and, one way or another, would complicate command and control operations, possibly telling the defender something about the attacking formations.

This is rear area mining oriented upon geography. An example of mining that is targeted on attacking troop formations is shown in Fig. 6. In Warsaw Pact doctrine for the breakthrough, the artillery from several divisions moves forward in this single motorized infantry division's zone. If it is allowed to get into firing position, it represents attacking firepower on the defender's position, and it is protected by an impressive amount of air defense capability. Tactical air strikes will be costly and perhaps too late. Minefield nodes on likely routes of advance might interfere with movement of some artillery and perhaps other tactical troops, delaying arrival of anticipated fire support and diluting the power of the attack.

Another use of mines in such a scenario involves target folders and Creek Braille type of attacks. Much of the Pact artillery will be headed for positions some 8 to 15 kilometers from the area of contact, where their range advantage will permit them to fire on the defender's positions with minimum problems from counterbattery fires. Careful intelligence work by the defender should provide a reasonable idea of which areas are likely to be used for firing positions within this relatively narrow band. This idea reinforces an earlier statement that the defender's targeting philosophy might better be oriented

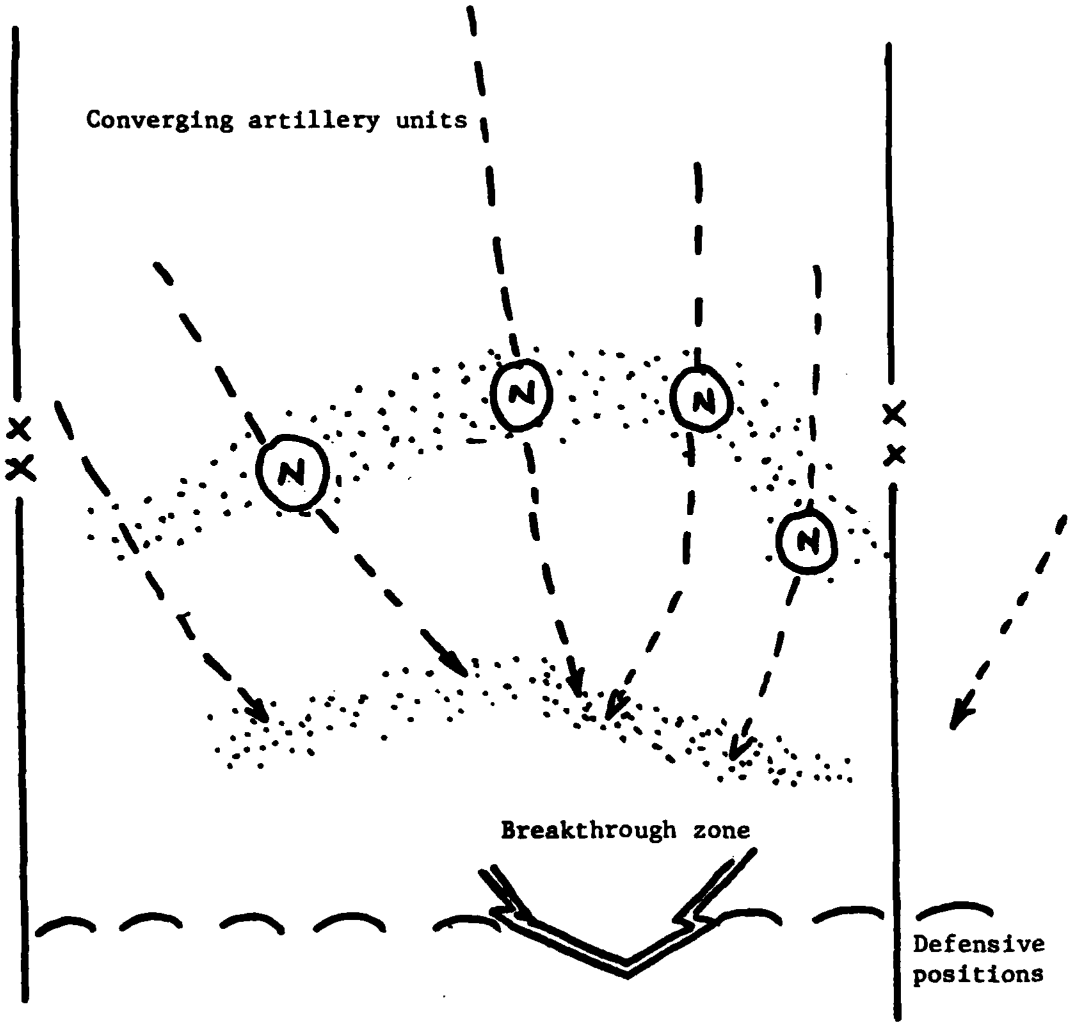


Fig. 6--Mining to disrupt attacker's artillery deployment

upon the overall effect of disruption and delay than primarily upon discrete destruction--in this case, counterbattery.

These brief vignettes suggest only a little of the "what" part of a concept--the "how" parts are far more difficult.

PROBLEMS FOR AIR FORCE EXPLOITATION OF MINE CAPABILITIES

The following areas appear to require attention so as to stimulate and guide the scatterable mine program in the Air Force:

Doctrine for employment. Joint service planning and coordination is necessary if mine barriers are to be placed where they will do the most good for the defender. Obviously, mines form only a part of the array of devices and techniques involved in stemming the flow of a major armored thrust; a systems approach to the whole problem seems indicated. Mining by tactical air delivery close to friendly troops will be difficult; mining the attacker's tactical rear areas appears to hold more promise. And there is the matter of targeting philosophy--targeting specifically for mine employment rather than solely for attack by discrete destruction weapons.

Mine hardware development. The current Gator-type mine is basically a close support device; if rear area mining is deemed more useful than close support mining, other types of mines also will be needed to provide an adequate mix. To make high speed routes of advance into dangerous routes, a remotely acting mine appears to be required. But the pace of mine development is extremely slow for Gator and for other devices still in the concept stage.

Delivery systems. Development in this field is also slow and seems to be taking an unprofitable direction--the mine-carrying capacity of dispensers declines with each new design. Delivery concept development is lagging as well, possibly as a result of the doctrinal

void discussed above. Standoff delivery of mines seems feasible, but is receiving little attention.

Mine and minefield effectiveness. Although destruction by mines can be measured and predicted with some accuracy, other effects--disruption, delay--are not now properly described by measures of effectiveness. Air Force and joint service testing and research seem to be indicated as a matter of some priority.

SUMMARY

This discussion has touched upon some aspects of the following hypotheses:

- The extensive array of mine countermeasure gear in Warsaw Pact ground forces formations suggests considerable respect for the potential of mines to impede armored vehicle mobility.
- In the absence of some delaying influence, Pact combat power can build up at a faster rate than a defender can cope with or maneuver to counter.
- Disruption may be viewed as a combination of vehicle destruction, formation delay and diversion, and interruption of orderly command and control. A number of related interactions that are subtle and not well understood currently cannot be defined or measured.

A number of opportunities appear to exist for useful employment of air scatterable land mines by tactical aircraft. But there are

some problems, as well, several of which may be reduced through joint service understanding, testing, and cooperation. An initial step in this direction might be an appreciation of countermobility as an attack objective, using disruption as the effect to be sought rather than destruction of discrete target elements.

NOTES

1. Robert J. Icks, Famous Tank Battles, Doubleday and Company, 1972, p. 341.

2. Alvin D. Coox and L. Van Loan Naisawald, Survey of Allied Tank Casualties in World War II (U), Operations Research Office, The Johns Hopkins University, Technical Memorandum ORO-T-117, March 1951 (Confidential), Table 1.

H. W. MacDonald et al., The Employment of Armor in Korea (U), Operations Research Office, General Headquarters, Far East Command, ORO-R-1 (FEC), July 1951 (Secret), Tables IIIA-IIIC and pp. 23-24, 223, 300-307.

Department of the Army, Headquarters United States Army Vietnam, Mine Warfare Center, Mine Warfare in Vietnam, August 1969, p. 66 and Enclosure 17.

3. Losses:

	Axis	British
Personnel		
Killed, etc.	2,000	13,500
Captured	24,000	
Tanks destroyed	180	600

Correlli Barnett, The Desert Generals, The Viking Press, 1961, pp. 251-271.

4. Russel H. Stolfi, Mine and Countermine Warfare in Recent History, 1914-1970, U.S. Army Aberdeen Research and Development Center, Ballistic Research Laboratories, Report No. 1582, April 1972, p. 38.

5. B.H. Liddell Hart, editor, The Rommel Papers, Harcourt Brace, 1953, pp. 455-458.

6. Gator Mine System, pamphlet provided by the Gator Systems Program Office, Eglin AFB, Fla., undated.

7. Department of the Army, Landmine Warfare, FM 20-32, 4 January 1971, p. 4-19.